THE JOINT EXAMINATION BOARD

PAPER P3

PREPARATION OF SPECIFICATIONS FOR UNITED KINGDOM AND OVERSEAS PATENTS

10th March, 1992

10.00 a.m. - 2.00 p.m.

Please read the following instructions carefully. This is a FOUR HOUR Paper.

1. Write on one side of the paper only using BLACK ink. You must write your examination number and the designation of the Paper in the top right hand corner of the sheet. You must not state your name anywhere in the answers.

2. NO printed matter or other written material may be taken into the examination room.

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10th March, 1992

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Your clients, who are a UK firm of marine engineers write to you as follows:-

"We have been asked to quote for the design and construction of releasable subsea connectors for installation in the North Sea as part of the mooring structure of a North Sea oil production platform which is being constructed for an oil company.

"The technical background, and our new design proposals, are described in the accompanying drawings in which:

"Figure 1 is a diagrammatic view of a so called tension leg platform;

"Figure 2 is a view in cross section of a prior art subsea connector for the anchoring structure of such a platform;

"Figure 3 is a diagrammatic partly cut away perspective view of a subsea connector according to our invention;

"Figure 4 is a sectional elevation of our connector device in a release condition and showing the tether line at an angle to the vertical; and

"Figure 5 is a sectional elevation of the device in an operative or locked condition.

"Figures 1 and 2 show the design proposals of the oil company and have been published in a technical press. Figures 3, 4 and 5 represent our new proposals.

"In figure 1, a tension leg platform 10 is shown positioned over a set of subsea foundations 12 of concrete or other suitable material. The platform 10 is maintained in position over the foundations 12 by plurality of mooring tethers 14. The mooring tethers 14 are joined to the foundations 12 and thereafter are placed in tension e.g. by de-ballasting the platform 10 so that it rises in the water.

"Figure 2 shows the proposals which have been published by the oil company for establishing the connection between the tethers 14 and the foundations 12. Each tether 14 which is tubular is to have a plug connector generally indicated as 16, at its lower end which fits into a socket connector 18 in the foundation 12. A mushroom head 20 at the lower end of the tether line 14 fits into a cavity 21 in the upper end of the plug connector 16. A flexible annular joint 22 (called a "flex joint") connects the head 20 to abutment surface 24 at the upper end of the cavity 21. In its normal state the tether 14 is in tension as indicated by the arrow 15, and the flex joint 22 permits universal movement of the tether 14 relative to the plug connector 16. This is

necessary because the platform 10 can move somewhat relative to the foundations 12 under the action of wind and tide, and that movement can be in any direction. The flex joint 22 also provides a fluid-tight closure for the cavity 21. When the tether 14 is being inserted into or removed from the socket 18, it is not under tension and in these conditions a concave bearing surface 25 on the underside of the head 20 rests on a spherical seat 26 in a lower wall of the cavity 21.

"The interior of the socket 18 is stepped to define an upper region 28 of relatively small diameter and a lower region 30 of relatively large diameter. It is formed with a support ring 32 which holds a release ring 34. The plug 16 carries a load ring 36 of springy material which when the plug 16 is inserted into the socket 18 snaps outwardly as shown to prevent subsequent withdrawal of the plug. Their idea is that if it is later required to uncouple and remove a tether 14 to allow periodic inspection thereof or as a result of damage then the tension in the tether 14 can be removed, the plug 16 will travel downwardly until the load ring 36 is held within the release ring 34, after which the plug 16 can be removed. If this mechanical system does not work, it is proposed to provide an hydraulic secondary release facility. The socket 18 is held in place by snap rings 38 and it is intended that supply of fluid from actuators 40 will contract the rings 38 and enable the plug 16 and socket 18 to be withdrawn together from the foundation 12.

"We have determined that these proposals are impractical. There is no way of lowering the plug 16 into position without risk of accidentally operating the mechanical release 34, 36. Furthermore, growth of marine organisms is certain to occur on the load ring 36 and release ring 34 which will prevent them working in the manner proposed. In addition, the problem of fluid supply to the hydraulic actuators 40 necessary for the secondary release has not been considered at all. The provision of separate marine tethers and hydraulic lines will add considerably to costs. The hydraulic lines will be vulnerable to damage, and they will probably need to be connected by divers, whereas the intended use of this kind of connection is at depths beyond that at which divers can safely operate.

"We have provided a subsea plug and socket connection for the tether lines in which again the mechanical connection of plug to socket establishes itself automatically when the plug is inserted into the socket, but in which release takes place on supply of fluid under pressure down the tether 14 which you will recollect is tubular.

"We provide a generally cylindrical socket 42 set into the subsea foundation 12. It defines a cylindrical plug-receiving space 44 having a reduced diameter mouth 46 having on its inner face a conical abutment 48. Within the cavity 44 there are radial fins 50 which carry upper and lower guide rings 52, 54 that serve to position the plug centrally within the space 44. The floor of the space 44 is provided with an upstanding stop member 56 that limits the downward travel of the plug. The plug has a body formed in two parts 60,62 to enable the mushroom head 20 to be inserted into the cavity 21. It has a lower part 60 and an upper part or locking ring 62 tightly bolted to the lower part. The mushroom head 20 of the tether line 14 fits below the locking ring 62 to which it is connected by a flex joint 22 as before, the abutment surface 24 being formed on an inner surface of the locking ring 62. The outer surface of the locking ring 62 is formed with an upper larger diameter conical seat 64, a lower smaller diameter conical seat 66 and a cam surface 68 connecting them. Fins 70 project outwardly from the body part 60 and carry guide rings 72, 74. A spring collet 76 surrounds the plug connector body 60 with the fingers 78, between which the fins 70 fit,

facing upwardly as shown, and defining at their uppermost ends a load ring 79. The fingers 78 tend to spring inwardly, but are held at their present diameter by engagement with one or other of the surfaces 64, 66 of the locking ring 62. At the hooked ends of the fingers 78 there are provided as part of the load ring inner conical surfaces 80 which snap onto the surfaces 64, 66 and outer surfaces 82 which in the working position of the plug (fig 5) butt against the socket mouth surface 48. The collet 76 can slide axially relative to body 60 between the release position shown in figure 4 and the locked position shown in figure 5.

"The closed lower end of the collet 76 carries an upwardly facing piston 84 which is slidably supported in a bore 86 of the connector body 60 and which has an enlarged head 88. Fluid communication between the interior of the tether 14 and the piston head 88 is provided by a vertical bore 90 through the spherical seat 26.

"In use, the tether line 14 is lowered so that the plug enters the socket 42. The collet is in its lower (fig 4) position relative to the body 60 and the load ring 79 is collapsed onto the lower seat 66. The plug moves downwardly until a buffer 92 at the lower end of the plug touches the end stop 56, after which no further downward movement of the collet 76 can take place. The connector body 60 continues to move downwardly under the weight of the tether line 14, disengaging the collet 76 from the surface 66 and allowing it to travel over the surface 68 until it snaps onto the upper surface 64. As this happens the base of the collet thrusts the piston 84 from the position shown in figure 4 upwardly to the position shown in figure 5. By this means the device reaches its locked state. As tension is applied to the tether line 14, the connector body 60 rises carrying the load ring 79 upwardly until its outer surfaces 82 engage the corresponding surfaces 48 of the socket mouth. Thereafter the end 20 of the tether line cannot escape from the socket and the load ring 79, provided by the ends of the fingers, is held between the locking ring 62 and the upper end of the socket so that they cannot disengage.

"The procedure for unlocking the device is as follows. Tension is removed from the tether line 14 to allow the connector body 60 and collet 76 to move downwardly within the socket 14.

"Fluid is then pumped down the interior of the tether line 24 and flows through the central bore 90 in the spherical seat 26. The fluid drives the piston 84 downwardly which forces the collet 76 downwards disengaging the load ring 79 from the upper surface 64 and allowing them to snap back onto the lower surface 66. The load ring has now returned to its collapsed state in which the collet and body can pass out of the socket when tension is re-applied to the tether line 14.

"In the normal load-carrying state of the device, the distance between the mushroom head 20 of the tether line and the mouth 46 of the socket is relatively small, and everything between them is in compression.

On the basis of the above letter, please draft:-

1) Claims for a UK patent application; (70 marks)

2) An introductory part of a specification of a patent application to be filed under the European Patent Convention up to but not including the description of the drawings. DO NOT include any description of the drawings and specific embodiments.

(30 marks)

FIG. 1

PRIOR ART

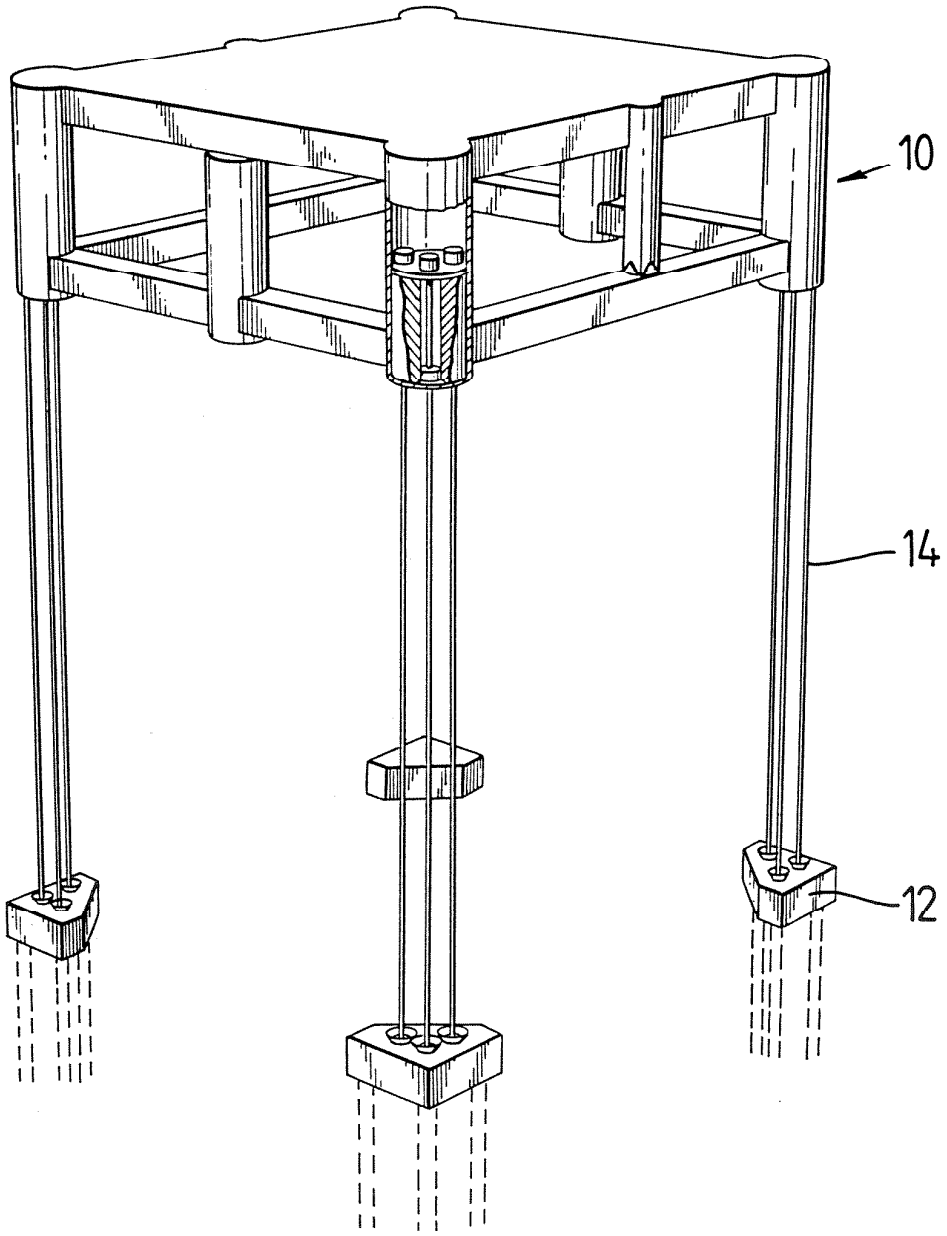

FIG. 2
PRIOR ART

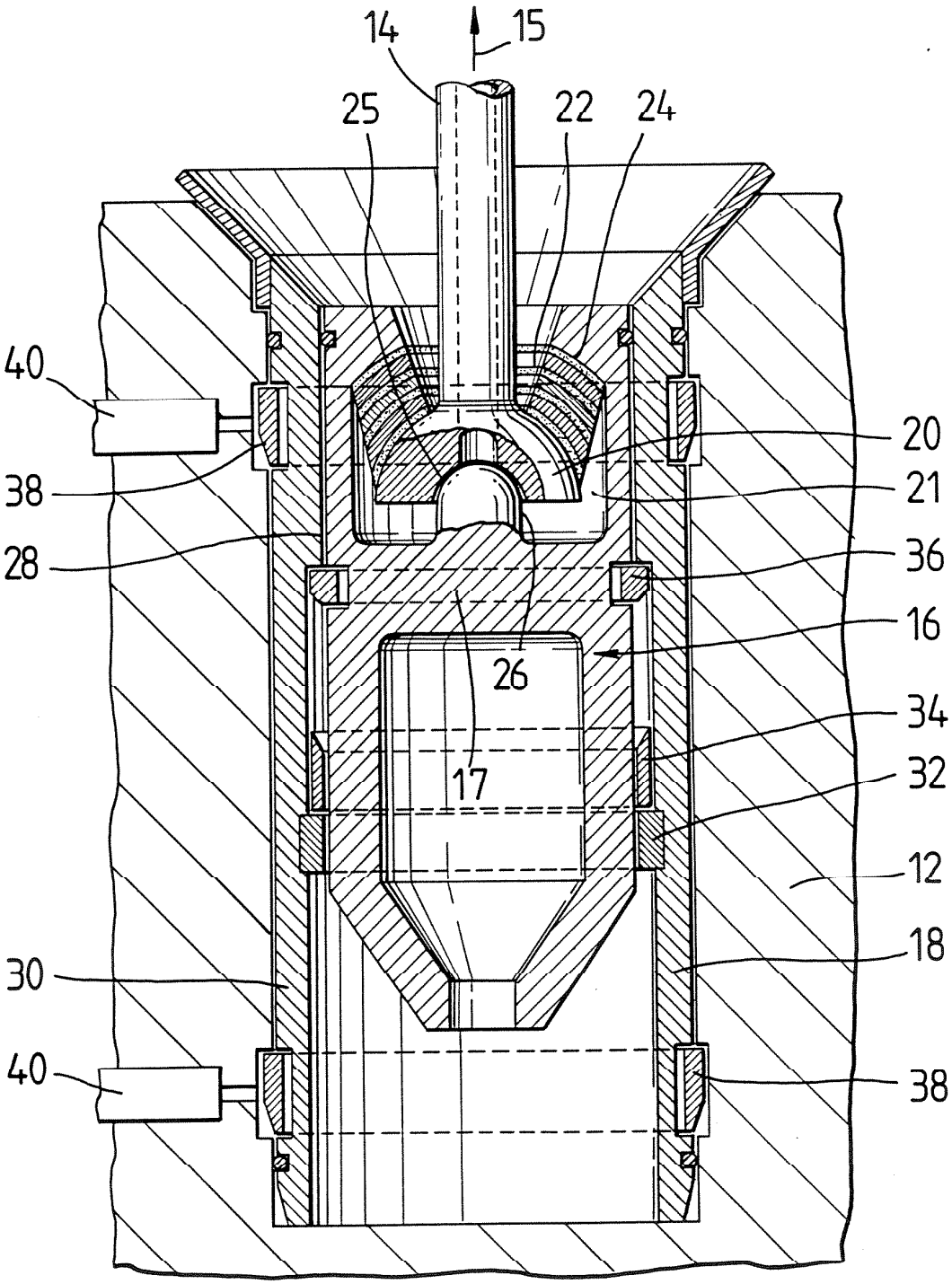

FIG. 3

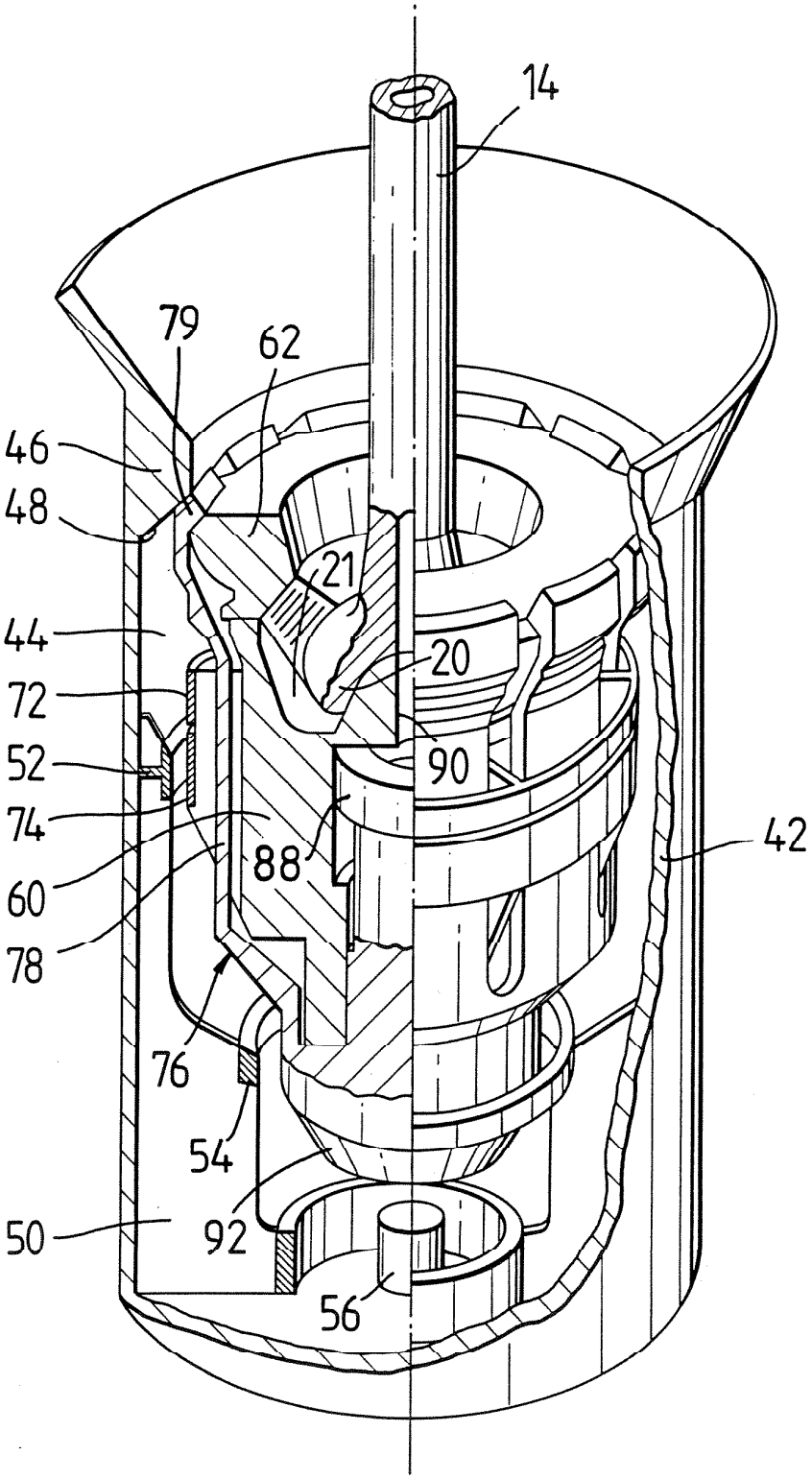

FIG.4

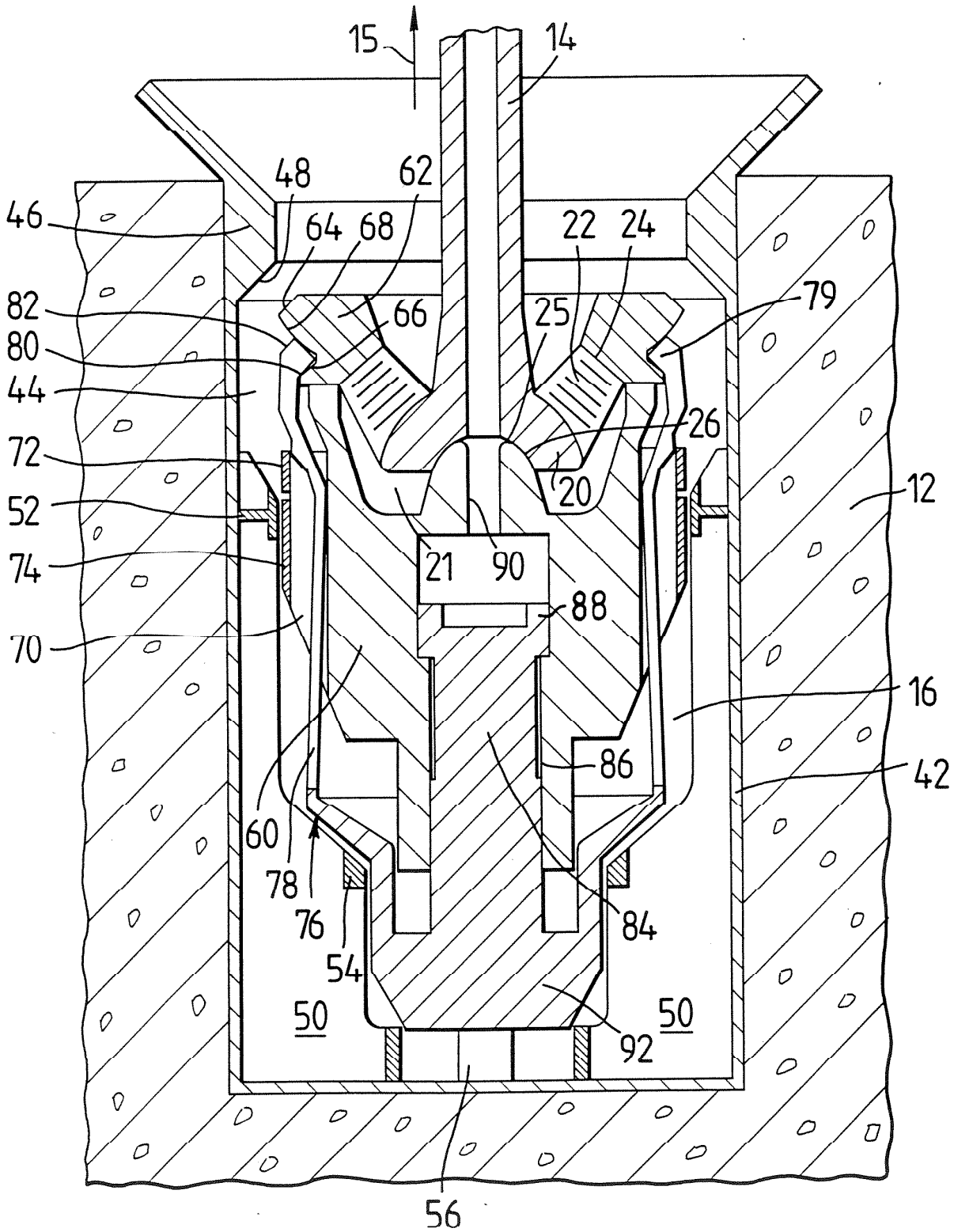

FIG.5